

EL1698692 92

EM156305 111

EL844053012

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION FOR LETTERS PATENT

\* \* \* \* \*

0950950  
101210950550  
A BATTERY POWERABLE APPARATUS, RADIO FREQUENCY COMMUNICATION DEVICE,  
AND ELECTRIC CIRCUIT

^ ~~Thin Profile Battery Bonding Method, Method Of~~  
~~Conductively Interconnecting Electronic Components,~~  
~~Battery Powerable Apparatus, Radio Frequency~~  
~~Communication Device, And Electric Circuit~~

\* \* \* \* \*

INVENTOR

Rickie C. Lake

ATTORNEY'S DOCKET NO. MI40-123





1 components to be electrically interconnected. At least one of the  
2 components comprises a metal surface with which the curable epoxy is  
3 to electrically connect. The epoxy is cured into an electrically  
4 conductive bond electrically interconnecting the first and second  
5 components. The epoxy has an effective metal surface wetting  
6 concentration of silane to form a cured electrical interconnection having  
7 a contact resistance through said metal surface of less than or equal to  
8 about 0.3 ohm-cm<sup>2</sup>.

9 The invention in a further aspect includes a battery powerable  
10 apparatus. In one implementation, such includes a substrate having a  
11 surface comprising at least one node location. A thin profile battery  
12 is mounted over the substrate and node location. A conductive  
13 adhesive mass electrically interconnects the thin profile battery with the  
14 node location, with the conductive adhesive mass comprising an epoxy  
15 terminated silane.

16 The invention in still a further aspect includes a radio frequency  
17 communication device. In one implementation, such includes a substrate  
18 having conductive paths including an antenna. At least one integrated  
19 circuit chip is mounted to the substrate and in electrical connection with  
20 a first portion of the substrate conductive paths. A thin profile battery  
21 is conductively bonded with a second portion of the substrate conductive  
22 paths by a conductive adhesive mass, with the conductive adhesive mass  
23 comprising an epoxy terminated silane.  
24

1 The invention in still another aspect includes an electric circuit  
2 comprising first and second electric components electrically connected  
3 with one another through a conductive adhesive mass comprising an  
4 epoxy terminated silane.

## 5 6 BRIEF DESCRIPTION OF THE DRAWINGS

7 Preferred embodiments of the invention are described below with  
8 reference to the following accompanying drawings.

9 Fig. 1 is a side elevational, partial cross sectional, view of a thin  
10 profile battery.

11 Fig. 2 is a side elevational view of a substrate.

12 Fig. 3 is a side elevational view of a battery powerable apparatus.

13 Fig. 4 is a diagrammatic plan view of a radio frequency  
14 communication device.  
15

## 16 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

17 This disclosure of the invention is submitted in furtherance of the  
18 constitutional purposes of the U.S. Patent Laws "to promote the  
19 progress of science and useful arts" (Article 1, Section 8).

20 Referring to Fig. 1, a single thin-profile battery is indicated  
21 generally with reference numeral 10. In the context of this document,  
22 "thin-profile battery" is intended to define any battery having a thickness  
23 dimension which is less than a maximum linear dimension of its anode  
24 or cathode. The preferred and illustrated battery 10 comprises a

1 circular button-type battery. Such comprises a lid terminal housing  
2 member 14 and a can terminal housing member 12. Can 12 is crimped  
3 about lid 14, having an insulative sealing gasket 16 interposed  
4 therebetween. In the illustrated example, gasket 16 projects outwardly  
5 slightly relative to the crimp as shown.

6 Fig. 2 illustrates a substrate 22 to which thin-profile battery 10  
7 is to be conductively connected. Substrate 22 includes an outer  
8 surface 23 having one node location 24 and another node location 25  
9 to which battery electrical connection is desired. Substrate 22, for  
10 example, can comprise a flexible circuit substrate, wherein nodes 24  
11 and 25 comprise printed thick film ink formed on surface 23.

12 Referring to Fig. 3, a curable adhesive composition or mass 26  
13 comprising an epoxy-terminated silane is interposed between lid 14 of  
14 thin profile battery 10 and substrate 22 over node location 25. Further,  
15 a curable adhesive composition or mass 32 comprising an  
16 epoxy-terminated silane is interposed between can 12 of thin-profile  
17 battery 10 and node location 24 on substrate 22. The preferred  
18 curable adhesive composition comprises a two-part epoxy resin and  
19 hardener system, wherein the preferred epoxy-terminated silane comprises  
20 a glycidoxy methoxy silane, such as a glycidoxypropyltrimethoxysilane,  
21 with 3-glycidoxypropyltrimethoxysilane being a specific example. The  
22 epoxy-terminated silane is preferably present in the curable adhesive  
23 composition at less than or equal to about 2% by weight, with less  
24 than or equal to about 1% by weight being even more preferred.







about 0.30 ohm-cm<sup>2</sup>. More preferred, the epoxy has an effective metal surface wetting concentration of silane to form a cured electrical interconnection have a contact resistance through said metal surface of less than or equal to about 0.16 ohm-cm<sup>2</sup>. Most preferred, such concentration provides a contact resistance of less than or equal to about 0.032 ohm-cm<sup>2</sup>.

The curable adhesive composition is then cured into an electrically conductive bond which electrically interconnects the battery and substrate as shown in Fig. 3. In the preferred embodiment, such electrically conductive bond also is the sole physical support and connection of the battery and its terminals relative to substrate 22.

Although the invention was reduced to practice utilizing formation of a conductive interconnection between a metal battery terminal and a printed thick film on a substrate, the invention has applicability in methods and constructions of producing an electric circuit comprising other first and second electric components which electrically connect with one another through a conductive adhesive mass comprising, in a preferred embodiment, an epoxy-terminated silane.

Fig. 3 depicts an exemplary battery powerable apparatus and electric circuit 30 in accordance with an aspect of the invention. In one preferred implementation, battery powerable apparatus 30 preferably comprises a radio frequency communication device 50 as exemplified in Fig. 4. In such example, substrate 22 preferably comprises a flexible circuit substrate, with nodes 25 and 24 constituting a portion of a series



